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DELAWARE RIVER BASIN  
LUBBERS RUN, SUSSEX COUNTY  
NEW JERSEY

LEVEL II

# LAKE LACKAWANNA

## DAM

### NJ 00817

DTIC  
ELECTE

AUG 11 1981

## PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

Lake Lackawanna Dam (NJ-00817).  
Delaware River Basin, Lubbers  
Run, Sussex County, New Jersey.  
Phase 1 Inspection Report.



① Final rept.,

② Abraham Perera

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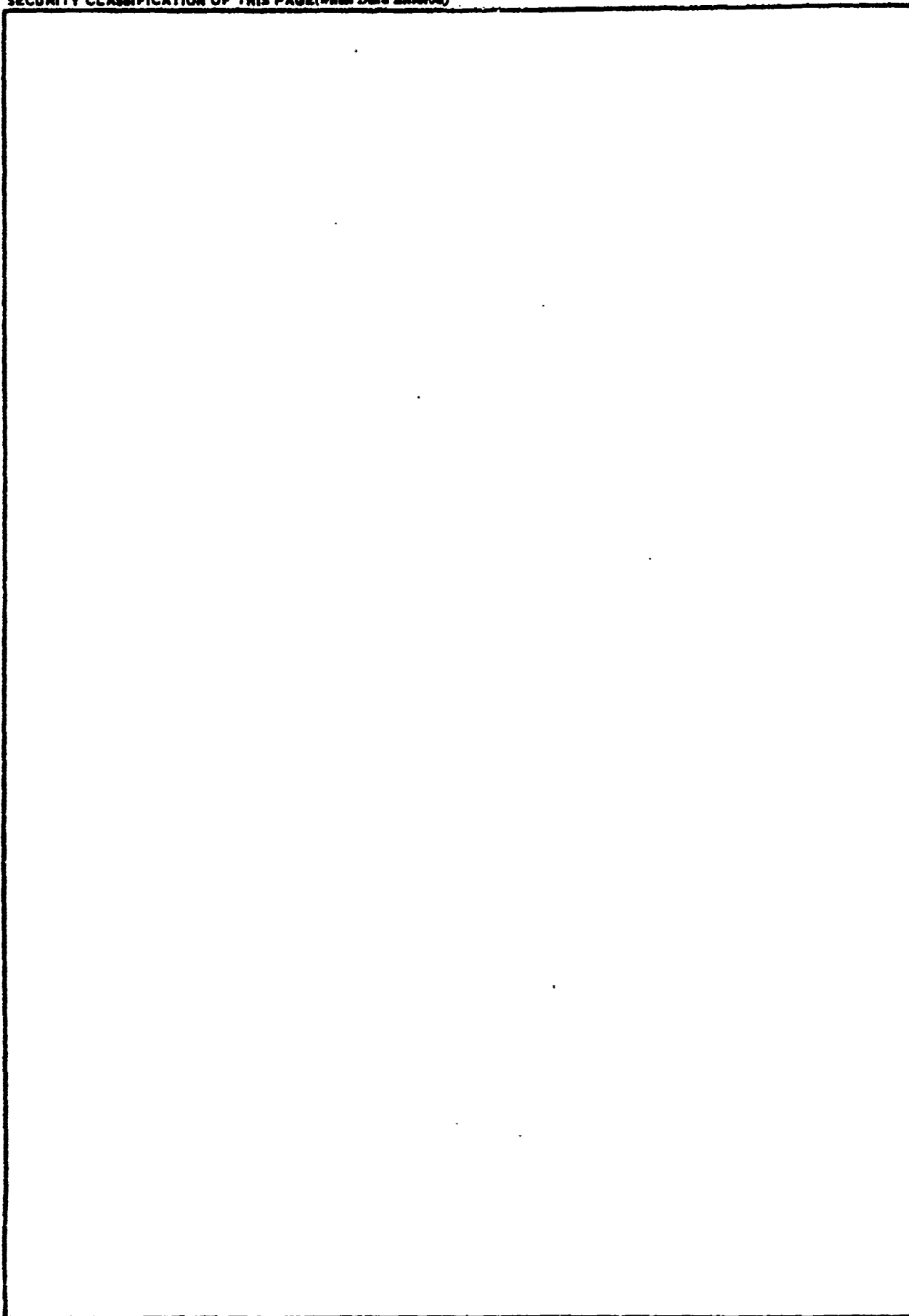
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Honorable Brendan L. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Lackawanna Dam, Sussex County, New Jersey which has been prepared under authorization of the Civil Inspection Act, Public Law 92-467. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Lackawanna Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 75 percent of the one hundred year flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using some sophisticated methods, procedures and success within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within three months from the date of approval of this report the owner should initiate a program to monitor the progress of the work at the dam and to report the results to the Corps of Engineers. The Corps will monitor the work and any necessary remedial measures.

c. Within three months from the date of approval of this report the following remedial actions should be initiated:

(1) The spillway and crest of the dam should be monitored for the entire area of the dam.

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NAPEN-N

Honorable Brendan T. Byrne

(2) Provide protection against wave erosion on the upstream face of the dam.

(3) Repair the deteriorated sections of concrete on the spillway wingwall and bridge soffit.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



ROGER L. BALDWIN  
Lieutenant Colonel, Corps of Engineers  
Commander and District Engineer

1 Incl  
As stated

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief  
Bureau of Flood Plain Regulation  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

LAKE LACKAWANNA DAM (NJ00817)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 4 February 1980 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Lackawanna Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 74 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within three months from the date of approval of this report the owner should initiate a program to monitor the seepage in the swale at the downstream toe near the left abutment to determine the source of the seepage and any necessary remedial measures.

c. Within twelve months from the date of approval of this report the following remedial actions should be initiated:

(1) The brush and trees on the embankment should be removed and the eroded areas filled and seeded.

(2) Provide protection against wave erosion on the upstream face of the dam.

(3) Repair the deteriorated sections of concrete on the spillway wingwall and bridge soffit.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

APPROVED:



ROGER L. BALDWIN

Lieutenant Colonel, Corps of Engineers  
Commander and District Engineer

DATE:

27 July 81


PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Lake Lackawanna Dam Fed ID# NJ 00817

State Located	<u>New Jersey</u>
County Located	<u>Sussex</u>
Coordinates	<u>Lat. 4056.8 - Long. 7442.1</u>
Stream	<u>Lubbers Run</u>
Date of Inspection	<u>February 4, 1981</u>

ASSESSMENT OF  
GENERAL CONDITIONS

Lake Lackawanna Dam is considered to be in generally good overall condition although its spillway capacity can accommodate only 73% of the 100-year design flood. It is recommended that the hazard classification be changed to significant since there are several homes and a road bridge downstream that could sustain damage in the event of a dam failure. Since the spillway capacity is inadequate, more precise hydraulic and hydrologic analyses should be undertaken to determine the need for, and type of, mitigating measures required. It is further recommended that the swale at the downstream toe near the left abutment be monitored to determine the source of the seepage. Other remedial measures to be undertaken in the future include the repair of the concrete at the spillway, removal of brush and trees from the embankment, repair of the eroded areas on the embankment, and the provision of riprap or other wave protection between the dock and spillway on the upstream face of the dam. It is further recommended that the owner develop a periodic maintenance program, an emergency action plan, and a warning system to reduce the downstream hazard potential.

  
\_\_\_\_\_  
Abraham Perera P.E.  
Project Manager



OVERVIEW OF LAKE LACKAWANNA DAM  
FEBRUARY, 1981

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## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines can be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I investigations is to identify expeditiously those dams that may pose hazards to human life or property. The assessment of the general condition of the dam is based on available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In the review of this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway test flood is based on the estimated "probable maximum flood" for the region (greatest reasonable possible storm runoff) or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
NAME OF DAM: LAKE LACKAWANNA DAM FED# NJ 00817

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Lake Lackawanna Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Lake Lackawanna Dam consists of a 224-foot-long earth embankment with an 86-foot-long concrete spillway at the right abutment. The embankment has a 3H:1V downstream slope, a crest width of 10 feet, and a 5-foot-wide concrete sidewalk and curb extending to the left abutment. A wooden deck has been constructed adjacent to a concrete headwall structure for the 40-inch-diameter steel drain pipe. A 6.5-foot-wide concrete bridge extends across the spillway at the centerline of the dam. The bridge is supported on three concrete piers, each of which is 2.67 feet wide. A concrete ogee weir located 10 feet upstream from the bridge discharges down a concrete apron to a 6-inch-high sill located 7 feet below the weir and 3 feet upstream of the bridge. The sill contains four 18-inch-wide notches placed to coincide with the center of the spillway channels between the bridge

piers. The clear opening between each pier beneath the bridge is 6.4 feet high by 19.5 feet wide. Downstream of the bridge the spillway empties into a bedrock channel at a point about 50 feet from the ogee weir.

b. Location

The dam is located on Lubbers Run approximately 6,650 feet northeast of the intersection of Route 206 and Lackawanna Drive in Byram Township, Sussex County, New Jersey. Access to the dam is possible via Route 206, Lackawanna Drive, Heminover Street, and Richmond Road.

c. Size Classification

The dam at Lake Lackawanna has a maximum height of 14.6 feet and a maximum storage capacity of 988 acre feet. Accordingly, this dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

The dam is located in a sparsely developed valley in rural Sussex County. There are, however, new homes being built in the Lake Lackawanna community downstream of the lake. Several of the homes are within 150 feet of the stream channel, and while they appear to be located several feet above the stream channel, it is possible they could sustain substantial flood damage in the event of a dam failure. Moreover, Heminover Street, a small local road serving the east half of the lake community, crosses over the stream channel about 225 feet downstream from the dam. Communication with Mr. David Rush, a representative of the owner, indicates that the Heminover Street bridge and roadway have been overtopped in the past during hurricanes, with no apparent damage to either structure. However it is believed that the flood wave created by a dam failure could cause serious damage to both the bridge and other downstream structures and possibly result in the loss of a few lives. Accordingly, it is recommended that this dam be placed in the significant hazard category.

e. Ownership

The dam is owned by the Lake Lackawanna Investment Co. who may be contacted through David Rush, 36 Richmond Road, Stanhope, N.J.

f. Purpose of Dam

The purpose of the dam is recreation.

g. Design and Construction History

No information is available regarding the design of the dam although it was built around 1954.

h. Normal Operating Procedures

Operating procedures at the dam consist of lowering the lake every third year to repair docks and perform routine maintenance on the dam, its spillway, and the intake to the low level drain. Periodic maintenance, consisting of debris removal and minor repair work is performed twice a year by members of the lake association.

1.3 PERTINENT DATA

a. Drainage Area

Lake Lackawanna Dam has a drainage area of 13.2 square miles, which consists primarily of sparsely developed woodlands.

b. Total spillway capacity at maximum pool elevation is 2,745 cfs.

c. Elevations

Top of dam	- 716.6
Spillway crest	- 712.5
Streambed at centerline of dam	- 702.0

d. Reservoir

Length of maximum pool  
(top of dam) - 4,900

Length of recreation pool  
(spillway crest) - 4,500

e. Storage (acre-feet)

Top of dam	- 988
Recreation pool	- 410

f. Reservoir Surface (acres)

Top of dam	- 166
Recreation pool	- 114

g. Dam

Type - Earth with concrete spillway at right abutment

Length - 310 feet

Height - 14.6 feet

Top width - 10 feet

Side slopes - 3H:1V downstream; upstream slope unknown

Zoning - Unknown

Impervious blanket - Unknown

Corewall - Unknown

Cutoff - Unknown

Grout curtain - Unknown

h. Diversion and Regulating Tunnel - None

i. Spillway

Type - Concrete ogee weir at right abutment

Weir length - 86 feet

Gates - None

U/S channel - None

D/S channel - Concrete lined, 21-foot-long positively sloped channel that steps down 1.25 feet to a natural, bedrock-lined channel.

j. Regulating Outlets

A 40-inch-diameter gate operated C.I.P drain is located at the junction of the embankment and the left abutment of the spillway. The pipe extends from a concrete headwall on the upstream side of the embankment diagonally through the spillway sidewall and empties into the spillway channel downstream of the concrete foot bridge at outlet invert elevation 704.0.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

No information was available regarding the Dam Application, design details, or details of the dam's construction. The NJDEP does not have microfilm records of this structure or a Dam Application number.

### 2.2 CONSTRUCTION

Although details pertaining to the construction of the dam were not available, information pertaining to the geology of the area was obtained from the Geologic Map of New Jersey and the Rutgers Engineering Soil Survey of Sussex County.

The dam is located in a narrow bedrock valley that is overlain by glacial drift and alluvium. The overburden consists of silty sands and gravels with an appreciable number of cobbles and boulders. The bedrock underlying the dam is Pre-Cambrian Losee gneiss, a hard, dense granitoid that exhibits a well-developed joint system. The bedrock is at the ground surface immediately downstream of the spillway.

### 2.3 OPERATION

There is no information available pertaining to formal dam operations. However, since the sole purpose of the dam is the impoundment of a lake for recreational purposes, the spillway appears adequate to perform, unattended, the water level regulation function at the dam.

### 2.4 EVALUATION

#### a. Availability

No design or construction information was available to the inspection team. The dam evaluation was based on geotechnical information available in the general literature of this area, field observations, and measurements made at the dam site.

b. Adequacy

Although none of the original design data was available for review, field observations and a literature review yielded sufficient information to evaluate this dam within the purview of PL 92-367.

c. Validity

There are no engineering data available for evaluation.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

Visual inspection of Lake Lackawanna Dam was performed on February 4, 1981, at which time about an inch of water was passing over the weir. The dam appears to be in a generally good condition, although the downstream embankment needs some cosmetic landscaping.

#### b. Dam

The dam's embankment is in fair condition although it exhibits some signs of neglect. Heavy brush and several trees were observed on the downstream face, and debris and garbage litter the backslope and the area immediately downstream. Minor erosion was noted at the center of the downstream slope and alongside the left wingwall of the spillway. While the vertical alignment of the crest is generally good, the upstream face of the embankment is somewhat irregular due to the establishment of a sandy bathing beach near the left abutment and the construction of a deck area near the gate structure of the outlet pipe on the upstream face. Wave action is funneled between the deck and the concrete walls adjoining the spillway, increasing the wave erosion at that point. Dampness was observed along the downstream toe, extending from the left abutment toward the center of the dam. A 75-foot-long drainage swale is located in this area and the wetness could be due to surface runoff from the abutment area rather than from seepage through the dam.

#### c. Appurtenant Structures

The spillway weir and side walls are in generally good condition, although some concrete spalling was noted at the downstream end of the right sidewall. Minor spalling was also observed at the soffit of the bridge arch nearest to the embankment. The outlet pipe also appeared in good condition as did the gate valve and headwall structure, although the wheel was missing from the gate stem. Removal of the wheel to prevent vandalism and unauthorized lowering of the lake is a common practice.

d. Reservoir

The lake is bounded on the west by relatively steep, wooded slopes. Almost the entire perimeter of the lake is developed with small summer and year round residences. Recent development is most heavy to the east and south of the lakes, where the terrain is flatter and more conducive to contemporary development norms. Ice precluded a thorough inspection of the upstream portions of the dam below the water line but there does not appear to be a significant build-up of sediment in front of the spillway. This could be due to the fact that Dallis Pond at the upstream end of Lake Lackawanna acts as a sediment trap, reducing the amount of siltation in the lower lake.

e. Downstream Channel

Discharge from the spillway flows down a natural bedrock, stone-laden channel to a road bridge about 225 feet beyond the toe of the dam. The opening of the bridge is 5 feet by 18 feet, and it would present a constriction to very heavy flows until the road adjacent to the bridge is overtopped. The channel gradient and side slopes flatten out about 1,300 feet downstream of the dam since the valley widens into a large swampy area, which extends to Route 206. Several recently built houses are located within 150 feet of the stream channel less than 1,000 feet downstream of the dam.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The dam functions essentially without regulation throughout the year. Every third year the owners get permission from the State Fish and Game Division to lower the lake for maintenance and dock repairs. The lake level remains down until repairs are completed, at which time the lake is left to refill to normal pool elevation. No other operational procedures are practiced as a matter of routine; however, members of the association are available to lower the lake level should extraordinary circumstances dictate such an action.

### 4.2 MAINTENANCE OF DAM

Maintenance of the dam and spillway is performed twice a year by members of the lake association. This work is generally limited to light landscaping and debris removal from the embankment, spillway, drain inlet, or downstream channel. When more extensive remedial work is required, the association engages the services of outside contractors specializing in the necessary types of repairs.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

As indicated above, maintenance of the drain is usually performed by members of the lake association. At present, this work is generally limited to cleaning debris and silt from the entrance and within the low level drain, lubricating and checking the operation of the gate valve every third year, and inspecting visible portions of the pipe for obvious defects or conditions requiring repairs.

### 4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

No formal warning system exists at the dam, although members of the association make periodic inspections of the dam and spillways.

#### 4.5 EVALUATION OF OPERATIONAL ADEQUACY

In view of the limited requirements placed on the regulatory facilities at the dam, the existing operational procedures are considered satisfactory. The employment of a regular periodic maintenance program is considered laudable, although it is felt that the association should direct more attention toward removal of the excessive growth on the dam embankment.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

#### a. Design Data

Pursuant to the Recommended Guidelines for Safety Inspection of Dams, Lake Lackawanna Dam is a small size and significant hazard dam. Accordingly, the 100-year frequency storm was chosen as the design flood by the inspecting engineers. Inflow to the reservoir for the selected storm was computed by the HEC-1 computer program utilizing precipitation data from Technical Paper 40 and Technical Memorandum NWS HYDRO-35, which gave a peak inflow of 4,616 cfs. Routing this storm through the reservoir reduced the peak discharge to 3,818 cfs. Because the spillway capacity is 2,799 cfs, it can only accommodate 73% of the 100-year storm and is therefore inadequate.

#### b. Experience Data

There are no streamflow records available for this site nor have records been kept regarding the dam's hydraulic performance since its construction.

#### c. Visual Observations

There is no evidence of recent problems. The lake level was at normal pool elevation at the time of inspection. Although the surface of the lake was entirely frozen, water was flowing over the weir.

#### d. Overtopping Potential

Employing the discharge and spillway capacities contained herein, the dam would be overtopped by 0.84 feet in the event of the 100-year frequency storm. However, there are no records or indications that the dam has ever been overtopped.

#### e. Drawdown

A 40-inch gate-controlled steel pipe is available for drawdown to elevation 705.5 NGVD. Draw down can be accomplished in approximately 5.6 days.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

No deficiencies of a structural nature were noted during the inspection of this dam. The crest is uniform in a horizontal plane and the height-to-width ratio is conservatively modest (1.4:1). No indications of mass movement of material, such as settlement, sloughing, or cracking, were noted.

#### b. Design and Construction Data

As indicated in Section 2, no information is available regarding the design or construction history of the dam. However, field observations reveal the dam is well built and conservative in design. Although the composition of the dam is unknown at present, the condition of the appurtenances is quite good, indicating a well supervised construction utilizing select materials throughout.

#### c. Operating Records

While no formal operating records are maintained by the lake association, the dam appears to have performed satisfactorily since its construction.

#### d. Post Construction Changes

The only modification at the dam appears to be the addition of a deck and bathing area on the upstream face, neither of which affect the structural integrity of the dam.

#### e. Seismic Stability

Lake Lackawanna Dam is located in Seismic Zone 1, where seismic activity is slight and additional structural loading imparted thereby is generally insignificant. Experience indicates that dams in Zone 1 that are stable under static loading conditions will maintain their structural integrity when subjected to the negligible dynamic loads imposed by the weak seismicity characteristic of this area. As indicated in the preceding paragraphs, this dam is considered stable under the existing static conditions.

## SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL ACTIONS

### 7.1 DAM ASSESSMENT

#### a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Lake Lackawanna Dam is judged to be in a good overall structural condition. However, the spillway is capable of accommodating only 73% of the 100-year frequency design flood. Some dam overtopping could be tolerated without serious consequences because of the low height of the dam, its high crest width-to-height ratio, and the fact that the embankment has 5-foot-wide concrete sidewalk pavement extending along, and protecting, its entire crest. It is recommended that this dam be placed in the significant hazard category because a dam failure could result in substantial damage to several residences and a road bridge downstream as well as the possible loss of a few lives.

#### b. Adequacy of Information

With the exception of visual observations, no information was available for use in assessing this dam. However, based on the good condition of the dam, it is felt that the inspection provided sufficient information with which to perform a cogent evaluation.

#### c. Urgency

Implementation of the recommendations pertaining to routine maintenance may be undertaken in the future. However, it is felt that monitoring of the seepage near the left abutment should begin very soon.

#### d. Necessity for Further Study

Since the spillway cannot accommodate the design storm, it is recommended that more precise hydrologic and hydraulic analyses be performed to determine the need for and type of mitigating measures that may be necessary.

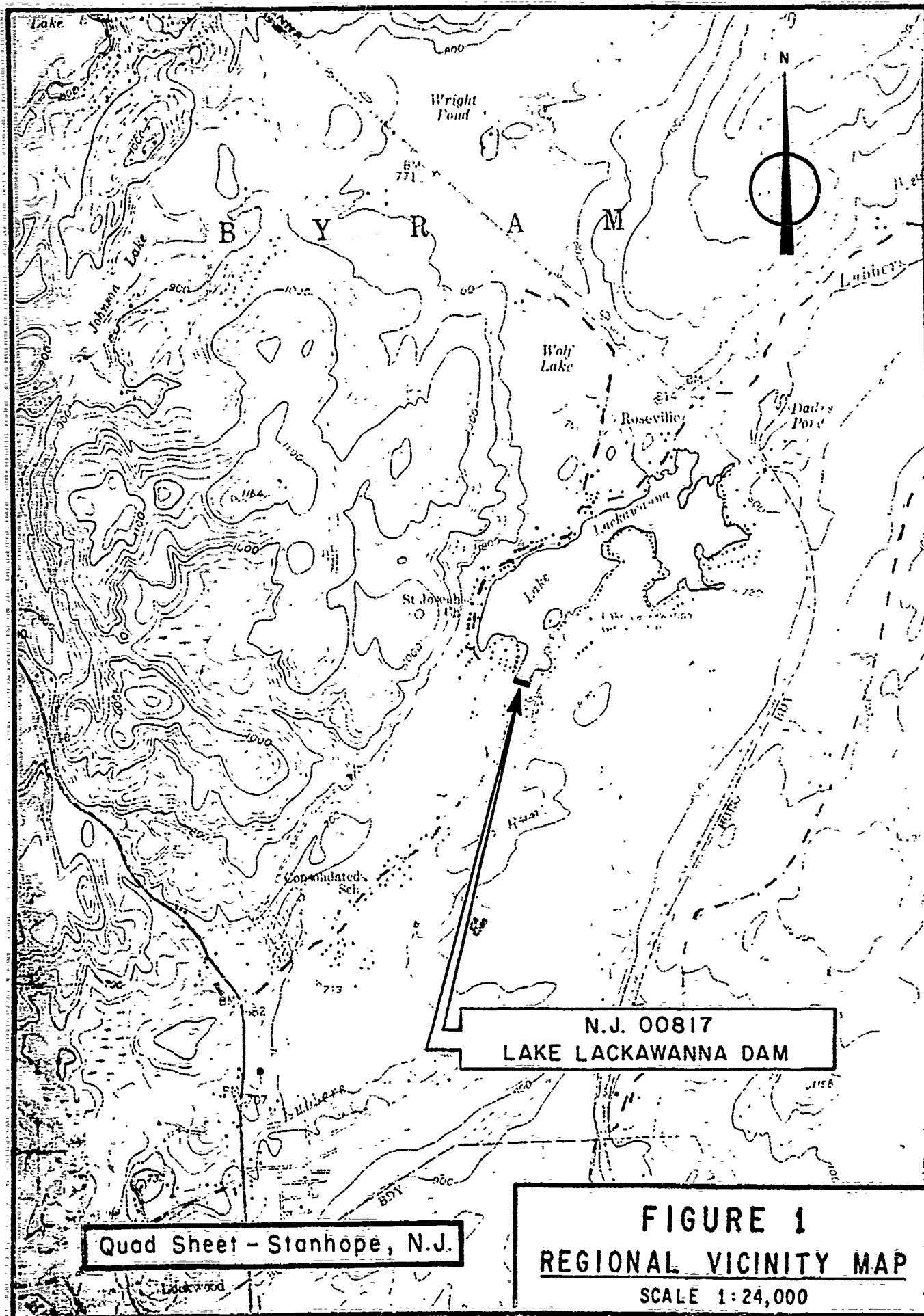
## 7.2 RECOMMENDATIONS/REMEDIAL ACTIONS

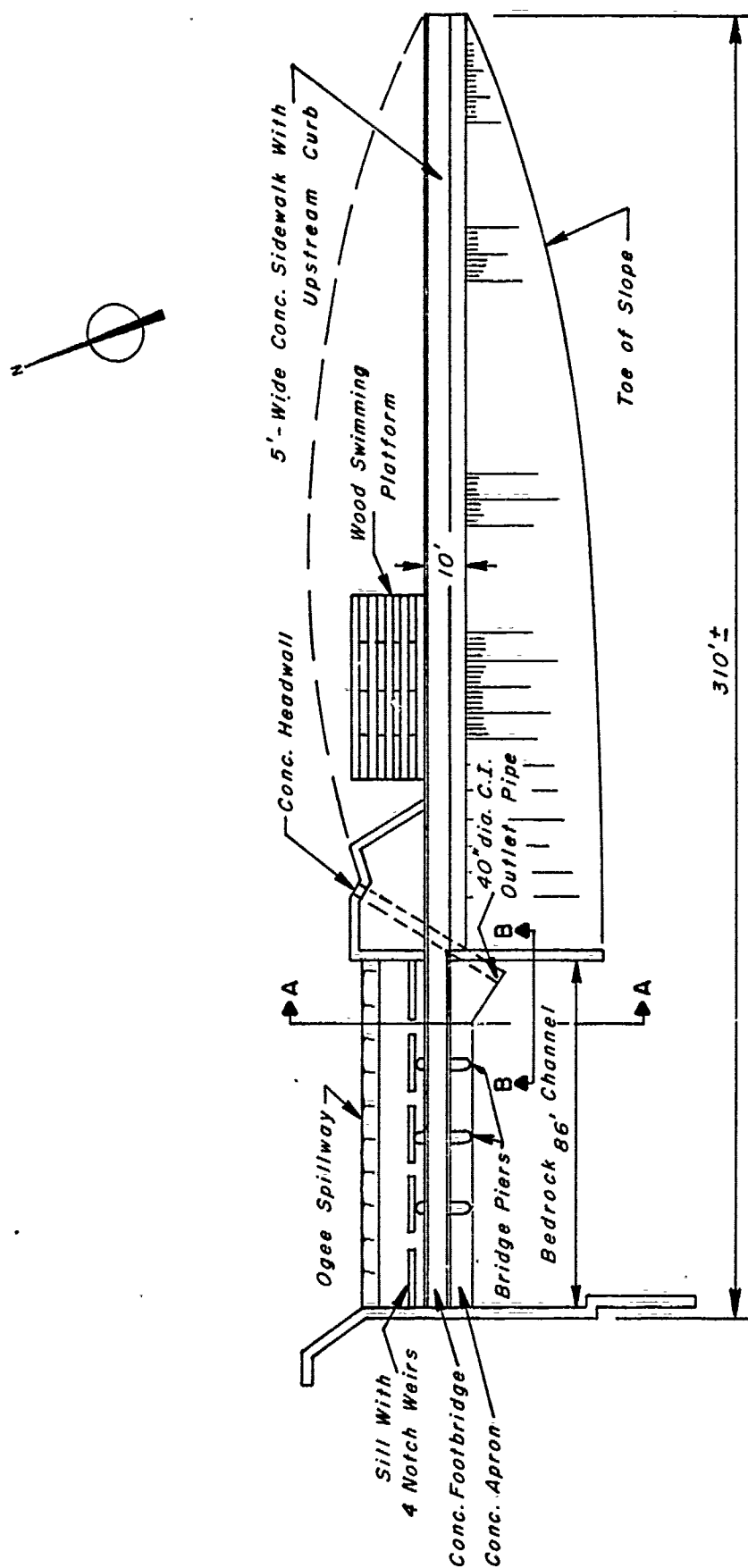
### a. Recommendations

It is recommended that monitoring of the seepage begin very soon to determine the remedial action required. The studies to be undertaken in the future should include additional hydraulic and hydrologic investigations to refine the magnitude of the design flood and spillway calculations. It is further recommended that the brush and trees on the embankment be removed and the eroded areas filled and seeded. Protection against wave erosion should be provided on the upstream face of the dam, and the deteriorated sections of concrete on the wingwall and bridge soffit should be repaired.

### b. O&M Maintenance and Procedures

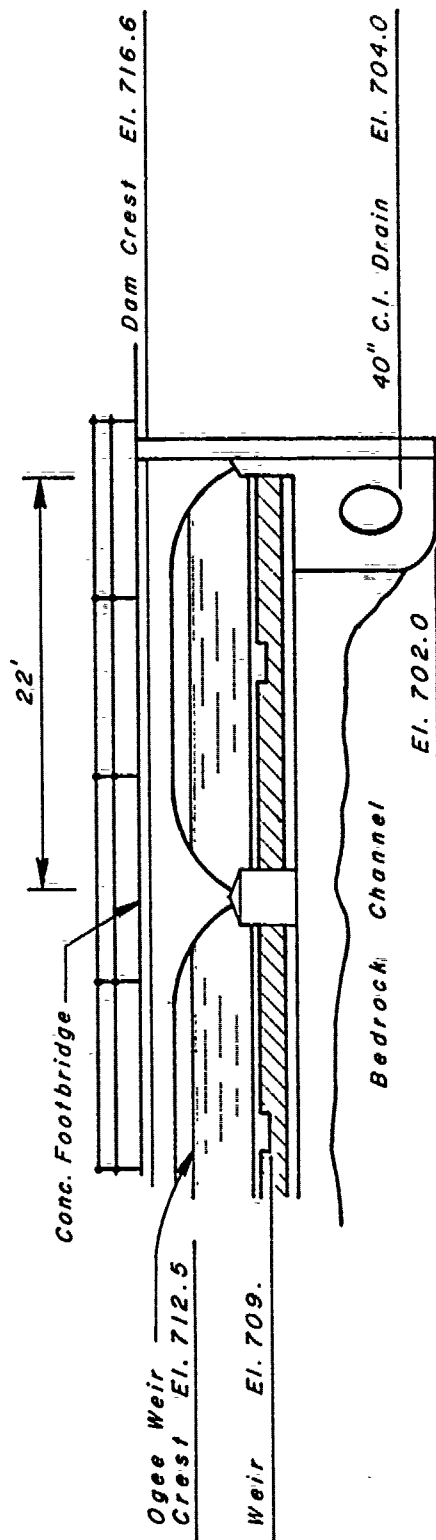
The owners should develop a periodic maintenance plan and establish routine operating procedures for the dam. These procedures should include periodic operation of the blowoff valve to ensure its proper functioning and keep the intake area free of excessive siltation. The owners should also create an emergency action plan and downstream warning system to minimize the potential for flood damage downstream.



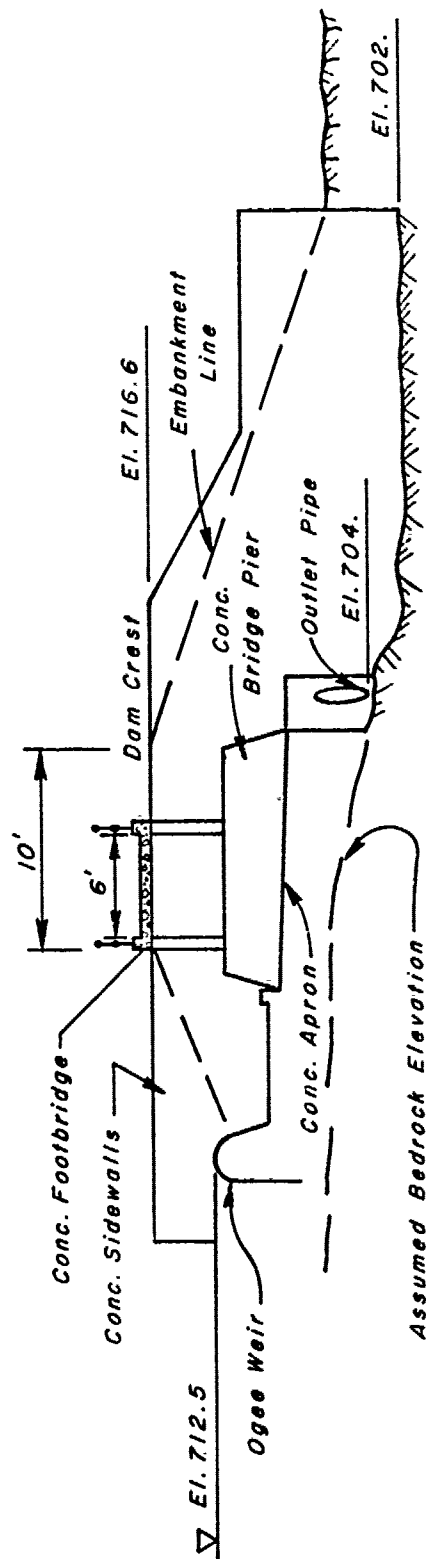


PLAN OF LAKE LACKAWANNA DAM  
NOT TO SCALE

FIGURE 2



SECTION B-B  
SPILLWAY PROFILE  
NOT TO SCALE



SECTION A-A  
SPILLWAY ELEVATIONS  
NOT TO SCALE

# LAKE LACKAWANNA DAM

Check List  
Visual Inspection  
Phase 1

Name Dam Lake Lackawanna Dam County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection 2-4-81 Weather Overcast Temperature 15°F

Pool Elevation at Time of Inspection 712.6 M.S.L. Tailwater at Time of Inspection 705.0 M.S.L.

Inspection Personnel:

T. Chapter J. Ceravolo

A. Perera

J. Greenstein No representative of owner present

T. Chapter Recorder

# EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Light erosion on center of downstream slope and at junction of embankment at left wingwall of spillway.	May be due to foot traffic. Should be filled, graded, and sodded.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Crest alignment is generally good. However, upstream face of embankment somewhat irregular due to establishment of a bathing beach at one end and construction of a deck near the spillway.	Wave action is funnelled between deck and concrete walls adjoining spillway, increasing erosion at this point. Eroded area should be filled and wave protection provided.
RIPRAP FAILURES	None observed	

# EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy brush and several trees growing on downstream face. Some debris and garbage littering backslope.	Debris should be cleared vegetation removed, and a thick grass cover re-established on the downstream face of dam.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Embankment grades smoothly into left abutment. Light erosion at junction of embankment and left sidewall of spillway.	No cracking or separation of earth noted.
ANY NOTICEABLE SEEPAGE	Light seepage (dampness) noted at the toe of the embankment. Drainage swale extends about 75' along the dam's toe from the left abutment.	Dampness could be due to surface runoff along swale rather than seepage through dam. Should be monitored.
STAFF GAGE AND RECORDER	None	
DRAINS	No toe drains observed. A 40" diameter steel drain extends diagonally from right end of embankment through wingwall and exits in main spillway channel.	Appears in good condition.

# OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	None observed	
OUTLET STRUCTURE	Concrete in good condition. Headwall structure functions as portion of main spillway's apron.	
OUTLET CHANNEL	Discharges into the main spillway channel of which the headwall structure is an integral component.	
EMERGENCY GATE	Gate wheel missing from valve stem although rest of equipment appears in good condition.	Gate wheel should be replaced and locked.

# UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	86' long ogee weir located at right abutment. Discharges over 6-inch-high sill located 7' downstream of the weir. Sill has 4 equally spaced 18" notches.	Concrete in good condition.
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	Downstream side of sill steps down 1.0' to sloping apron. Second 1.25' step located 15' downstream of sill. Channel contained by 7' high sidewalls on both sides for 50' below ogee weir. Discharges on natural stone bottomed channel.	Light spalling on right downstream sidewall. Should be patched.
BRIDGE AND PIERS	6.5'-wide concrete foot bridge across channel 10 feet downstream of weir. Bridge supported on 3, 2'8"-wide concrete piers. Soffits are 7.25' above apron with rounded corners producing an arch effect for the openings.	Light spalling on soffit arch nearest embankment. Should be patched.
	V	

# INSTRUMENTATION

VISUAL EXAMINATION NONUMENTATION/SURVEYS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	None observed	
OBSERVATION WELLS	None observed	
WEIRS	Centrally located notches in the raised sill on the apron could function as low flow monitoring weirs if they were calibrated.	
PIEZOMETERS	None observed	
OTHER	vi	

# RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Lake surrounded by homes on shorelines. Hills rise abruptly from lake with exception of north-east and southwest ends of valley. Hills are generally underdeveloped and heavily forested.	
SEDIMENTATION	Ice precluded close observation but siltation did not appear excessive behind dam or spillway.	
	vii	

# DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Clear stone bottomed channel. Road bridge about 225 feet downstream.	
SLOPES	Stream channel has gentle gradient (.002) and enters a very wide marshy valley 1,000' below dam.	
APPROXIMATE NO. OF HOMES AND POPULATION	20 homes along stream valley within 1,000' of dam. Estimate 80-100 people in residence.	Most of homes appear to be above the elevation of the dam crest. However, several about 800' downstream could be near enough to the stream to receive some flood damage.

**CHECK LIST**  
**ENGINEERING DATA**  
**DESIGN, CONSTRUCTION, OPERATION**

ITEM	REMARKS
PLAN OF DAM	Not available
REGIONAL VICINITY MAP	U.S.G.S. Stanhope, N.J., Quadrangle
CONSTRUCTION HISTORY	Not available
TYPICAL SECTIONS OF DAM	"
HYDROLOGIC/HYDRAULIC DATA	"
OUTLETS - PLAN	"
- DETAILS	"
- CONSTRAINTS	"
- DISCHARGE RATINGS	"
RAINFALL/RESERVOIR RECORDS	"

ITEM

REMARKS

SPILLWAY PLAN

SECTIONS

DETAILS

OPERATING EQUIPMENT  
PLANS & DETAILS

Not available

"

"

x

ITEM	REMARKS
------	---------

## DESIGN REPORTS

Not available

## GEOLOGY REPORTS

" "

DESIGN COMPUTATIONS  
HYDROLOGY & HYDRAULICS  
DAM STABILITY  
SEEPAGE STUDIES

" " " " " "

MATERIALS INVESTIGATIONS  
BORING RECORDS  
LABORATORY  
FIELD

" " " " " "

## POST-CONSTRUCTION SURVEYS OF DAM

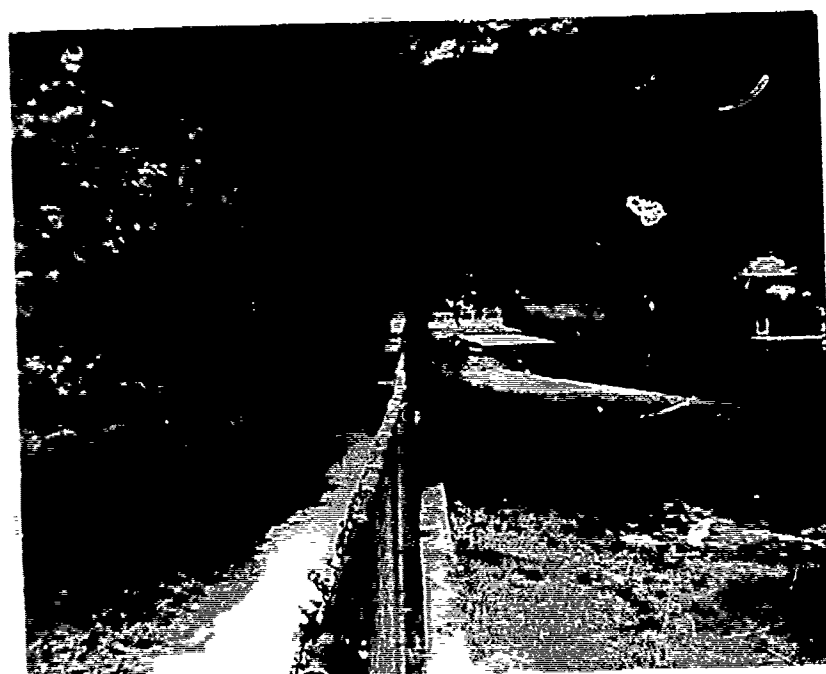
" "

## BORROW SOURCES.

" "

xf

ITEM	REMARKS
MONITORING SYSTEMS	None observed
MODIFICATIONS	Not available
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	" "
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	" " "
MAINTENANCE OPERATION RECORDS	" " "



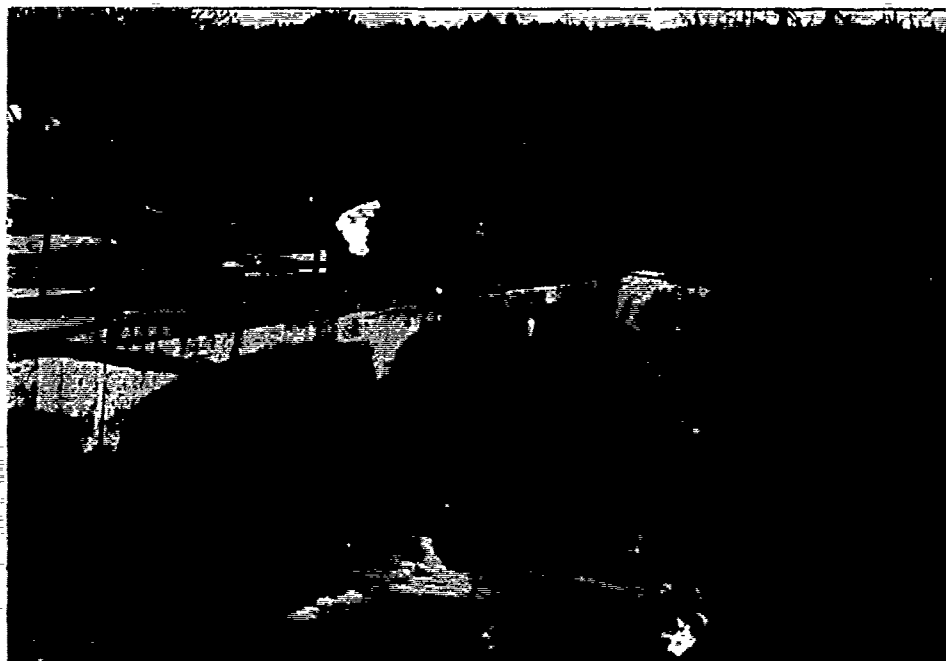
February, 1981

View of Dam Crest



February, 1981

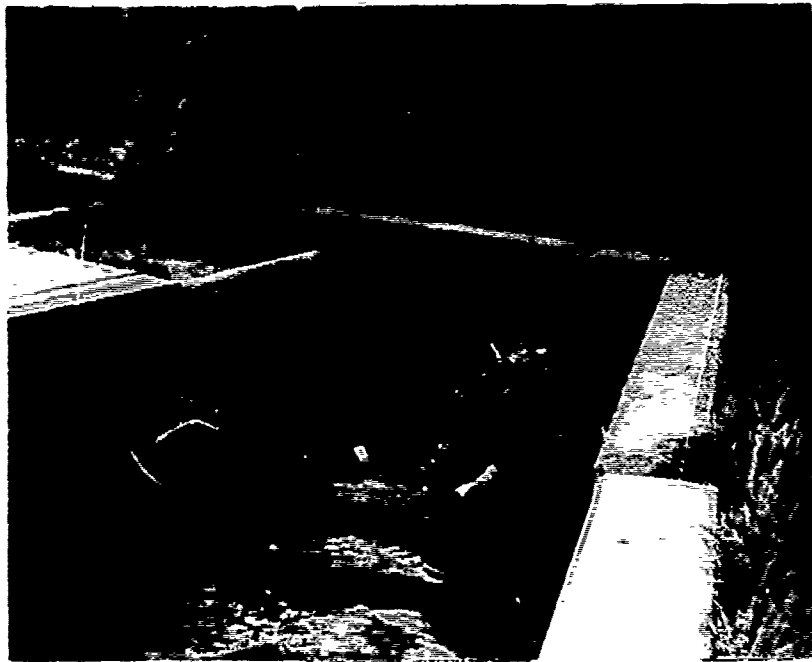
View of Swimming Dock



February, 1981  
View of Spillway Bridge and Outlet Pipe



February, 1981  
View of Ogee Weir and Sill Notch



February, 1981

Erosion At Upstream Embankment



February, 1981

View of Outlet Pipe



February, 1981

Downstream View of Spillway



February, 1981

View of Downstream Channel from Dam

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 13.2 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 712.5 (410 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): -

ELEVATION MAXIMUM DESIGN POOL: -

ELEVATION TOP DAM: 716.6 (988 acre-feet)

CREST: Spillway

- a. Elevation 712.5
- b. Type Ogee weir
- c. Width 2.5 feet
- d. Length 86 feet
- e. Location Spillover Right abutment
- f. Number and Type of Gates None

OUTLET WORKS: Gate operated low level drain

- a. Type 40" diameter C.I. pipe
- b. Location Junction embankment and spillway
- c. Entrance inverts 705.5
- d. Exit inverts 704.0
- e. Emergency draindown facilities Saine

HYDROMETEOROLOGICAL GAGES: None

- a. Type
- b. Location
- c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 2,799 cfs

BY J. Cervato DATE 3/20/91

## LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. 1 OF 14

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

LARI LACRAVINO DAPROJECT 10-11SUBJECT INFLOW HYDRO-11

SYNTHETIC UNIT HYDROGRAPH

Laguer Coefficient: 1.0 (From Corps of Engineers)

$$C_2 = 2.0$$

$$C_1 = 0.62$$

$$A = 13.22 \text{ SQ. MI.}$$

$$L = \text{Length of longest watercourse} = 32,000' = 6.06 \text{ MI.}$$

$$L_{ca} = \text{Length along watercourse to Centroid} = 17000' = 3.22 \text{ MI.}$$

$$T_L = \text{LAG TIME} = C_2 (LL_{ca})^{0.5}$$

where  $C_2$  = Coef. representing  
variation of watershed  
slope & storage

$$t_L = 2.0 (6.06 \times 3.22)^{0.5} = 2 \times 2.43$$

$$t_p = t_L = 4.86 \text{ HOURS}$$

BY J. Ceravolo DATE 7/2/81

LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. AS OF A14

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

LEON LASKARANA DAIPROJECT CS 276

SUBJECT \_\_\_\_\_

105 YL STORM PRECIPITATION

Precipitation Data from TP-40 E NOAA Technica,

Memorandum, NWS Hydro - 35

12 HOUR DURATION

TIME	PRECIPITATION	$\Delta$	REARRANGED $\Delta$
0.5	2.30	2.30	0.12
1.0	3.00	0.70	0.14
1.5	3.44	0.44	0.18
2.0	3.75	0.31	0.20
2.5	4.02	0.27	0.23
3.0	4.25	0.23	0.27
3.5	4.45	0.20	0.70
4.0	4.63	0.18	2.30
4.5	4.79	0.15	0.44
5.0	4.94	0.15	0.31
5.5	5.06	0.14	0.15
6.0	5.20	0.12	0.15
6.5	5.33	0.13	0.13
7.0	5.45	0.12	0.12
7.5	5.54	0.09	0.10
8.0	5.62	0.08	0.10
8.5	5.69	0.07	0.10
9.0	5.85	0.06	0.10
9.5	5.95	0.10	0.09
10.0	6.05	0.10	0.08
10.5	6.13	0.08	0.08
11.0	6.20	0.07	0.07
11.5	6.30	0.10	0.07
12.0	6.40	0.10	0.06

BY J.C. DATE 3/25/91  
CHKD. BY DATE  
SUBJECT

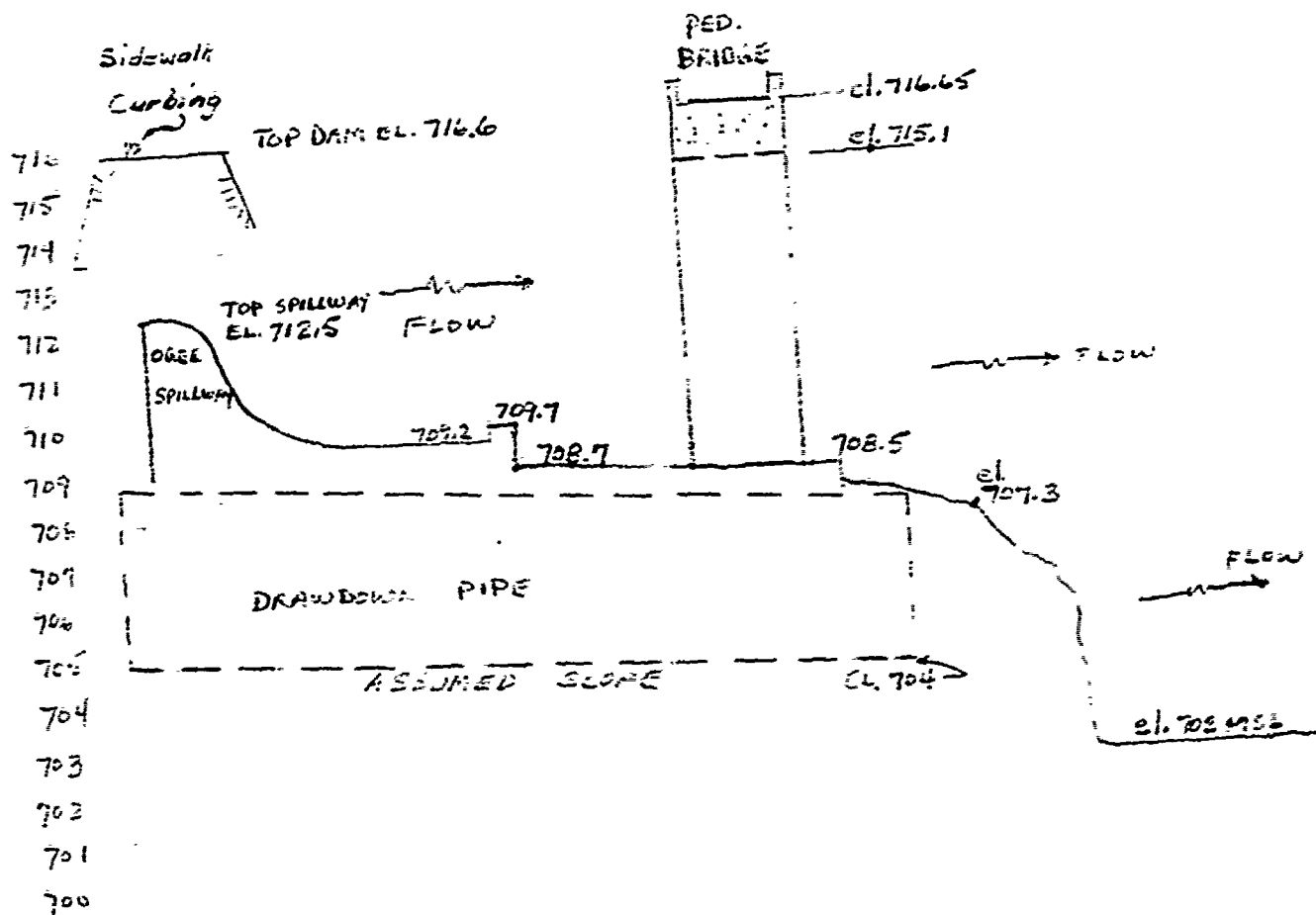
# LOUIS BERGER & ASSOCIATES INC.

Lake Lachryna Dam

Steel - Discharge

Drainage

SHEET NO. 13 OF 14  
PROJECT EL. 278



BY J. Ceravolo DATE 3/25/81

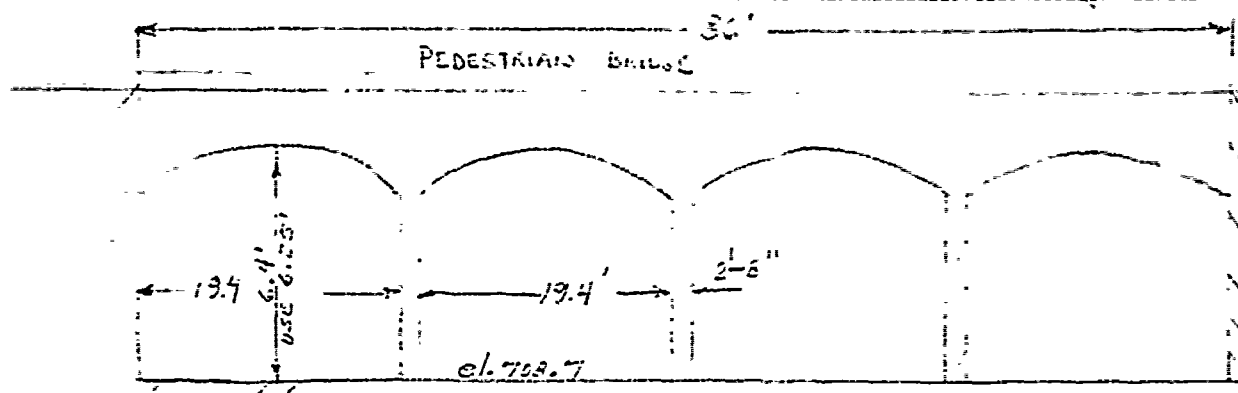
# LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 112 OF 112

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

PROJECT ST. LOUIS

SUBJECT ST. LOUIS DISCHARGE CALCULATIONS BRIDGE (112-71-112)



ELEVATION (MSL)	HEADWATER DEPTH HW (FT.)	HW/D	BRIDGE WIDTH (FT.)	DISCHARGE PC. FT. Q (CFS)	DISCHARGE Q (CFS)	TOTAL DISCHARGE Σ Q (CFS)	FLOW CU. FT. MIN.	FLOW CU. FT. MAX.	Σ Q
708.7	0	0	19.4	0	0	0			0
710.0	1.3	.21	"	4	73	310			310
711.0	2.3	.37	"	10	194	776			776
712.0	3.3	.53	"	18	349	1397			1397
712.5	3.8	.61	"	22	427	1707			1707
713.0	4.3	.69	"	27	524	2095			2095
714.0	5.3	.95	"	36	698	2744			2744
714.5	5.8	.99	"	38	727	2947			2947
715.0	6.3	1.02	"	45	873	3492			3492
716.0	7.3	1.17	"	55	1067	4265			4265
717.0	8.3	1.33	"	62	1202	4911	153	59	5023

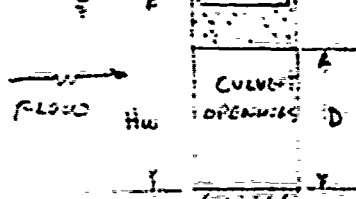
NOTES: 1. USED HYDRAULIC ENG. CIR. # 5 FOR CULVERT HYDRAULIC TREATING BRIDGE AS 4 CULVERTS AT INLET CHANNEL.

2. HEIGHT OF BRIDGE TO CROWN = 6.4'. USE D = 6.25' FOR HEIGHT OF BRIDGE TO COMPENSATE FOR ARCH. CROWN.

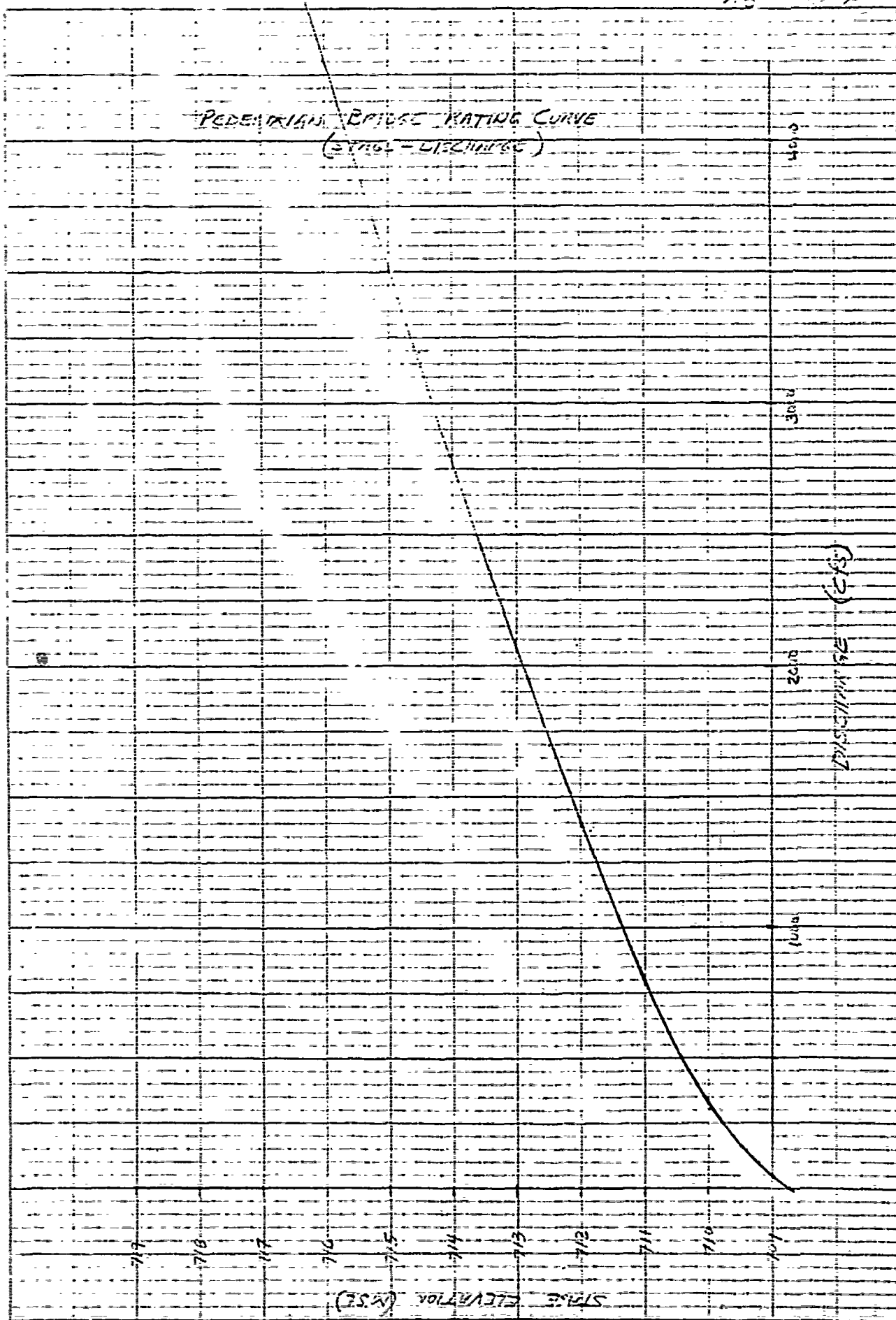
3. FLOW OVER DAM WAS CALCULATED USING WEIR EQUATION:

$$C = 2.7 \quad L = 224'$$

4. el. TOP DAM = 716.6



PEDESTRIAN BRIDGE RATING CURVE  
 (STAGE - DISCHARGE)



(5-2) 75 M/11/25/17

BY J.C. DATE 1/22/51  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

# LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 46 OF 46  
 PROJECT C-27

LINKS LEXINGTON DAM  
STAG. DISCHARGE

FLOW OVER SPILLWAY OGEE SPILLWAY : $Q = CLH^{3/2}$ $L = 86'$				THIN WATER EFFECT ON SPILLWAY DUE TO SUBMERGENCE				FLOW OVER DAM TOP OF DAM (@ 716.6 $L = 224$ $C = 2.7$ $Q = CLH^{3/2}$		TOTAL Q
$C$ VARIABLE										
$H = h_e = W.S. ELEV ABOVE SPILLWAY CREST$										
$P = \text{Depth Behind Spillway} = 5'$										
1	2	3	4	5	6	7	8	9	10	11
ELEV.	H ( $h_e$ ) (ft)	C	Q (cfs)	TW ELEV From Sheet A7 (Col 4) (Column 4)	* $\frac{h_d}{h_e}$	$h_d$ ( $h_e \times 0.6$ )	SPILLY ELEV. DUE TO SUBM. ( $Tw + (h_e \times 0.6)$ (Col 5 + 7))	GOVERNING ELEVATION (LARGER OF (COL 1 OR 8))	H	Q
712.5	0		0				712.5			0
713.0	0.5	3.95	120	710.2	.6	.3	713.3	713.0		120
714.0	1.5	3.95	624	710.7	"	.9	711.6	714.0		624
715.0	2.5	3.95	1343	711.8	"	1.5	713.0	715.0		1343
715.5	3.0	3.94	1760	712.6	"	1.8	714.4	715.5		1760
715.6	3.1	3.94	1849	712.7	"	1.86	714.6	715.6		1849
716.0	3.5	3.94	2214	713.2	"	2.1	715.3	716.0		2214
716.2	3.7	3.93	2465	713.4	"	2.22	715.62	716.2		2465
716.6	4.1	3.92	2799	714.0	"	2.46	716.46	716.6		2799
717.0	4.5	3.88	3185	714.5	"	2.7	717.2	717.2	.6	281
717.5	5.0	3.84	3701	715.2	"	3.0	718.2	718.2	1.6	1224

$h_e$   $h_d$

SPILLWAY

\* Depth Submergence  
 right to give full weir  
 Flow: Design at water dam - Sta 254

465 (J781)

STAFF DISCHARGE: FIVE

7-10-68 7/10/68

ॐ

5

2017

10



15/05/2013 (17)

215

715716

512

5/16

73.5

12.5

HEIGHT OVER 50 INCHES (17)

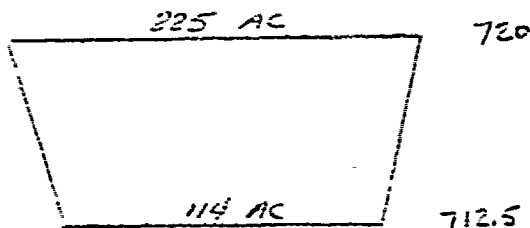
Equation (MSL)

BY J.C. DATE 3/22/81  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

# LOUIS BERGER & ASSOCIATES INC.

SHEET NO. AE OF 12  
 PROJECT LL 27

LAKE LACMAIANA DAM  
STAGE - SURFACE STORAGE



SURFACE AREAS MEASURED ON STANHOPE N.J. QUAD SHEET  
 100 UNITS ON PLANIMETER = 1" 1000 FT. = 1"

$$\text{EL. 712.5} - 125 \text{ UNITS} = 1.25' \frac{4,000,000}{43,560} = 114 \text{ ACRES}$$

$$\text{EL. 720} - 245 \text{ UNITS} = 2.45' \frac{4,000,000}{43,560} = 225 \text{ ACRES}$$

ELEVATION (NGVD)	HT ABOVE SPILLWAY (FT.)	SURFACE AREA (AC.)	SURCHARGE VOLUME (AC-FT)	TOTAL STORAGE AC-FT
712.5	0	114	0	410
720.0	7.5	225	1271	1711

BY J.C. DATE 3/25/81

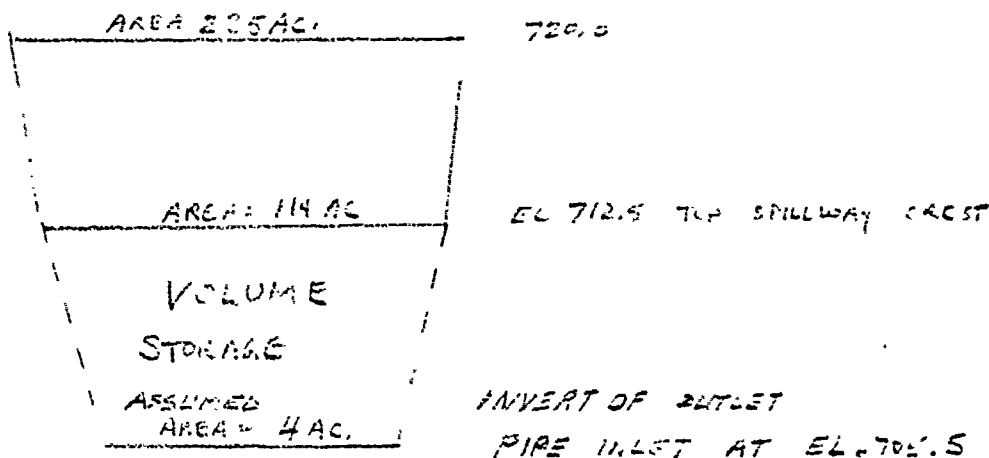
LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 13 OF 14

CHKD. BY DATE LAKE LICKED AREA DAM

PROJECT CC 376

SUBJECT DRAWDOWN CALCULATIONS



ASSUME DRAWDOWN TO ELEV 705.5

FOLLOWING SLOPE OF LAKE DOWN TO BOTTOM LAKE AREA BOTTOM = 4 AC.

$$VOLUME = \frac{114 + 4}{2} \times 7.0 = 413.0 \text{ AC. FT.} \text{ SUM } 410 \text{ AC. FT.}$$

DRAWDOWN BY GATE CONTROLLED 40" STEEL PIPE  
FROM ELEV. 712.5 TO ELEV. 705.5

FIND FLOW USING HYD. ENG. CIR. #5 FOR CULVERT HYDRAULICS  
INLET CONTROL

$$MAX \quad \frac{H_w}{D} = \frac{712.5 - 705.5}{(40') \cdot 3.33'} = \frac{7.0}{3.33} = 2.1$$

$$Q = 100 \text{ cfs}$$

$$MIN \quad Q = 0$$

$$AVERAGE \quad Q = 50 \text{ cfs}$$

ASSUME NORMAL INFLOW OF 12 CFS/IN. = 13 CFS.

$$\therefore \Sigma \text{ OUTFLOW} = 37 \text{ CFS}$$

$$DRAWDOWN TIME = \frac{410 \text{ AC. FT.} \times 43.56 \text{ ft}^2/\text{ac}}{37 \text{ cfs} \times 3600 \text{ sec/hr}} = 124 \text{ HRS}$$

$$DRAWDOWN TIME = 5.6 \text{ DAYS}$$

BY J.C. DATE 7/2/81

## LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. 11 OF 119

CHKD. BY DATE

LAKE LACKAWANA DAM

PROJECT 3276

SUBJECT HEC 1 DB

A1 LAKE LACKAWANA DAM HEC1DB

A2 J. CERAVOLO

A3 MARCH 25, 1981

B 100 0 30 0 0 0 0 0 0 0

B1 3

K 0 1

K1 INFLOW HYDROGRAPH TO RESERVOIR

M 0 1 13.22

O 24

O1 .12 .14 .18 .20 .23 .27 .70 2.3 .44 .31

O1 .15 .15 .13 .12 .10 .10 .10 .10 .09 .08

O1 .08 .07 .07 .06 .5 .1

T

W 4.88 .62

X 0 0

K 1 2

K1 ROUTED FLOWS THROUGH RESERVOIR

Y 1

Y1 1

Y4 712.5 713 714 715 716 716.6 717.2 718.2

Y5 0 120 624 1343 2219 2799 3466 4925

YA 114

YE 712.5

YA 712.5

YD 716.6

K 99

## JOB SPECIFICATION

NG	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			3	0	0	0			

## INFLOW HYDROGRAPH TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

## HYDROGRAPH DATA

HYDQ	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	1	13.22	0.00	13.22	0.00	0.000	0	0	0

## PRECIP PATTERN

0.12	0.14	0.18	0.20	0.23	0.27	0.70	2.30	0.44	0.31
0.15	0.15	0.13	0.12	0.10	0.10	0.10	0.10	0.09	0.08
0.08	0.07	0.07	0.06						

## LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=10.86 AND R= 9.20 INTERVALS

## SUB-AREA RUNOFF COMPUTATION

## PRECIP DATA

NP	STORM	DAJ	DAK
24	0.00	0.00	0.00

## UNIT HYDROGRAPH DATA

TP= 4.88 CP=0.62 NTA= 0

## RECESSION DATA

STRTO= 0.00 GRCSN= 0.00 RTIOR= 1.00

## UNIT HYDROGRAPH 55 END-OF-PERIOD ORDINATES, LAG= 4.87 HOURS, CP= 0.62 VOL= 1.00

35	130.	262.	415.	580.	749.	899.	1011.	1092.	1111.
1084.	1000.	877.	804.	721.	647.	580.	520.	467.	419.
375.	337.	302.	271.	243.	218.	195.	175.	157.	141.
126.	113.	102.	91.	82.	73.	66.	59.	53.	47.
43.	38.	34.	31.	28.	25.	22.	20.	18.	16.
14.	13.	12.	10.	9.					

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

## HYDROGRAPH ROUTING

NSTPS	NSTD	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0	-1

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

PROJECT 5050

MO. DA	HR. MIN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP G	MD. PA	HR. MIN	PERIOD	RAIN	EXCS	LOSS	COMP G
1.01	0.30	1	0.12	0.00	0.12	0	1.02	1.30	51	0.00	0.00	0.00	174.
1.01	1.01	2	0.14	0.00	0.14	0.	1.02	2.00	52	0.00	0.00	0.00	156.
1.01	1.30	3	0.18	0.00	0.18	0.	1.02	3.00	53	0.00	0.00	0.00	140.
1.01	2.00	4	0.20	0.10	0.10	4.	1.02	4.00	54	0.00	0.00	0.00	125.
1.01	2.30	5	0.23	0.18	0.05	20.	1.02	5.00	55	0.00	0.00	0.00	112.
1.01	3.00	6	0.27	0.22	0.05	58.	1.02	6.00	56	0.00	0.00	0.00	101.
1.01	3.30	7	0.70	0.65	0.05	142.	1.02	7.00	57	0.00	0.00	0.00	90.
1.01	4.00	8	2.30	2.25	0.05	356.	1.02	8.00	58	0.00	0.00	0.00	81.
1.01	4.30	9	0.44	0.39	0.05	750.	1.02	9.00	59	0.00	0.00	0.00	72.
1.01	5.00	10	0.31	0.26	0.05	1276.	1.02	10.00	60	0.00	0.00	0.00	63.
1.01	5.30	11	0.15	0.10	0.05	1883.	1.02	11.00	61	0.00	0.00	0.00	55.
1.01	6.00	12	0.15	0.10	0.05	2532.	1.02	12.00	62	0.00	0.00	0.00	44.
1.01	6.30	13	0.13	0.08	0.05	3181.	1.02	13.00	63	0.00	0.00	0.00	20.
1.01	7.00	14	0.12	0.07	0.05	3756.	1.02	14.00	64	0.00	0.00	0.00	15.
1.01	7.30	15	0.10	0.05	0.05	4199.	1.02	15.00	65	0.00	0.00	0.00	9.
1.01	8.00	16	0.10	0.05	0.05	4616.	1.02	16.00	66	0.00	0.00	0.00	8.
1.01	8.30	17	0.10	0.05	0.05	4955.	1.02	17.00	67	0.00	0.00	0.00	6.
1.01	9.00	18	0.10	0.05	0.05	4323.	1.02	18.00	68	0.00	0.00	0.00	5.
1.01	9.30	19	0.09	0.04	0.05	4018.	1.02	19.00	69	0.00	0.00	0.00	4.
1.01	10.00	20	0.08	0.03	0.05	3714.	1.02	20.00	70	0.00	0.00	0.00	3.
1.01	10.30	21	0.08	0.03	0.05	3425.	1.02	21.00	71	0.00	0.00	0.00	2.
1.01	11.00	22	0.07	0.02	0.05	3154.	1.02	22.00	72	0.00	0.00	0.00	1.
1.01	11.30	23	0.06	0.01	0.05	2700.	1.02	23.00	73	0.00	0.00	0.00	1.
1.01	12.00	24	0.06	0.00	0.00	2441.	1.02	24.00	74	0.00	0.00	0.00	1.
1.01	12.30	25	0.00	0.00	0.00	2233.	1.02	25.00	75	0.00	0.00	0.00	0.
1.01	13.00	26	0.00	0.00	0.00	2036.	1.02	26.00	76	0.00	0.00	0.00	0.
1.01	14.00	27	0.00	0.00	0.00	1852.	1.02	27.00	77	0.00	0.00	0.00	0.
1.01	14.30	28	0.00	0.00	0.00	1679.	1.02	28.00	78	0.00	0.00	0.00	0.
1.01	15.00	29	0.00	0.00	0.00	1517.	1.02	29.00	79	0.00	0.00	0.00	0.
1.01	15.30	30	0.00	0.00	0.00	1368.	1.02	30.00	80	0.00	0.00	0.00	0.
1.01	16.00	31	0.00	0.00	0.00	1105.	1.02	31.00	81	0.00	0.00	0.00	0.
1.01	16.30	32	0.00	0.00	0.00	992.	1.02	32.00	82	0.00	0.00	0.00	0.
1.01	17.00	33	0.00	0.00	0.00	889.	1.02	33.00	83	0.00	0.00	0.00	0.
1.01	17.30	34	0.00	0.00	0.00	798.	1.02	34.00	84	0.00	0.00	0.00	0.
1.01	17.00	35	0.00	0.00	0.00	715.	1.02	35.00	85	0.00	0.00	0.00	0.
1.01	18.00	36	0.00	0.00	0.00	642.	1.02	36.00	86	0.00	0.00	0.00	0.
1.01	18.30	37	0.00	0.00	0.00	575.	1.02	37.00	87	0.00	0.00	0.00	0.
1.01	19.00	38	0.00	0.00	0.00	516.	1.02	38.00	88	0.00	0.00	0.00	0.
1.01	19.30	39	0.00	0.00	0.00	463.	1.02	39.00	89	0.00	0.00	0.00	0.
1.01	20.00	40	0.00	0.00	0.00	415.	1.02	40.00	90	0.00	0.00	0.00	0.
1.01	20.30	41	0.00	0.00	0.00	372.	1.02	41.00	91	0.00	0.00	0.00	0.
1.01	21.00	42	0.00	0.00	0.00	334.	1.02	42.00	92	0.00	0.00	0.00	0.
1.01	21.30	43	0.00	0.00	0.00	269.	1.02	43.00	93	0.00	0.00	0.00	0.
1.01	22.00	44	0.00	0.00	0.00	241.	1.02	44.00	94	0.00	0.00	0.00	0.
1.01	22.30	45	0.00	0.00	0.00	216.	1.02	45.00	95	0.00	0.00	0.00	0.
1.01	23.00	46	0.00	0.00	0.00	194.	1.02	46.00	96	0.00	0.00	0.00	0.
1.01	23.30	47	0.00	0.00	0.00		1.03	47.00	97	0.00	0.00	0.00	0.
1.01	23.00	48	0.00	0.00	0.00		1.03	48.00	98	0.00	0.00	0.00	0.
1.02	0.00	49	0.00	0.00	0.00		1.03	49.00	99	0.00	0.00	0.00	0.
1.02	1.00	50	0.00	0.00	0.00		1.03	50.00	100	0.00	0.00	0.00	0.
SUM 6.29 4.75 1.53 80709													
( 160.)( 121.)( 39.)( 2285.42)													

BY J.C. DATE 7/2/81

## LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. A15 OF A14

CHKD. BY DATE

LAKE LOSCARLOS DAM

PROJECT C-276

SUBJECT

HEC 1 DE

## ROUTED FLOWS THROUGH RESERVOIR

	ISTAG 2	ICOMP 1	IECON 0	ITAPE 0	JPLT 0	JPR1 0	INAME 1	ISTAGE 0	IAUTO 0
	ROUTING DATA								
	GLOSS 0.0	CLOSS 0.000	AVG 0.00	IRES 1	ISAME 0	IOPT 0	IPMP 0	LSTR 0	
STAGE	712.50	713.00	714.00	715.00	716.00	716.60	717.20	718.20	
FLOW	0.00	120.00	624.00	1343.00	2219.00	2799.00	3466.00	4925.00	
SURFACE AREA=	114.	225.							
CAPACITY=	0.	1248.							
ELEVATION=	713.	720.							

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
712.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA			
TOPEL	COGD	EXPD	DAMWID
716.6	0.0	0.0	0

END-OF-PERIOD HYDROGRAPH ORDINATES				STORAGE		STAGE	
MO. DA	HR MN	PERIOD	HOURS	INFLOW	OUTFLOW		
1.01	0.30	1	0.50	0.	0.	0	712.5
1.01	1.00	2	1.00	0.	0.	0	712.5
1.01	1.30	3	1.50	0.	0.	0	712.5
1.01	2.00	4	2.00	4.	0.	0	712.5
1.01	2.30	5	2.50	20.	1.	1	712.5
1.01	3.00	6	3.00	58.	4.	2	712.5
1.01	3.30	7	3.50	142.	12.	6.	712.6
1.01	4.00	8	4.00	356.	32.	15	712.6
1.01	4.30	9	4.50	750.	74.	36.	712.8
1.01	5.00	10	5.00	1276.	178.	72.	713.1
1.01	5.30	11	5.50	1883.	394.	126.	713.5
1.01	6.00	12	6.00	2532.	676.	195.	714.1
1.01	6.30	13	6.50	3181.	1100.	276.	714.7
1.01	7.00	14	7.00	3756.	1574.	364.	715.3
1.01	7.30	15	7.50	4199.	2077.	453.	715.8
1.01	8.00	16	8.00	4490.	2560.	537.	716.4
1.01	8.30	17	8.50	4616.	3004.	610.	716.8
1.01	9.00	18	9.00	4555.	3370.	668.	717.1
1.01	9.30	19	9.50	4323.	3652.	706.	717.3
1.01	10.00	20	10.00	4018.	3799.	725.	717.4
1.01	10.30	21	10.50	3714.	3818.	727.	717.4
1.01	11.00	22	11.00	3425.	3747.	718.	717.4
1.01	11.30	23	11.50	3154.	3617.	702.	717.3
1.01	12.00	24	12.00	2900.	3452.	681.	717.2
1.01	12.30	25	12.50	2663.	3299.	656.	717.0
1.01	13.00	26	13.00	2441.	3126.	629.	716.9
1.01	13.30	27	13.50	2233.	2941.	600.	716.7
1.01	14.00	28	14.00	2036.	2755.	571.	716.6
1.01	14.30	29	14.50	1852.	2583.	541.	716.4
1.01	15.00	30	15.00	1679.	2407.	511.	716.2
1.01	15.30	31	15.50	1517.	2230.	481.	716.0
1.01	16.00	32	16.00	1368.	2069.	452.	715.8
1.01	16.30	33	16.50	1231.	1910.	423.	715.6
1.01	17.00	34	17.00	1105.	1754.	396.	715.5
1.01	17.30	35	17.50	992.	1604.	370.	715.3
1.01	18.00	36	18.00	889.	1461.	345.	715.1
1.01	18.30	37	18.50	798.	1329.	322.	715.0
1.01	19.00	38	19.00	715.	1223.	301.	714.8
1.01	19.30	39	19.50	642.	1121.	280.	714.7
1.01	20.00	40	20.00	575.	1023.	261.	714.6
1.01	20.30	41	20.50	516.	932.	243.	714.4
1.01	21.00	42	21.00	463.	846.	227.	714.3
1.01	21.30	43	21.50	415.	766.	212.	714.2
1.01	22.00	44	22.00	372.	692.	198.	714.1
1.01	22.30	45	22.50	334.	625.	185.	714.0
1.01	23.00	46	23.00	300.	580.	174.	713.9
1.01	23.30	47	23.50	269.	536.	162.	713.8
1.02	0.00	48	24.00	241.	494.	151.	713.7
1.02	0.30	49	24.50	216.	455.	141.	713.7
1.02	1.00	50	25.00	194.	417.	132.	713.6
1.02	1.30	51	25.50	174.	382.	123.	713.5
1.02	2.00	52	26.00	156.	349.	115.	713.5

BY J.C. DATE 7/2/51  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.

LAKE LACKAWANA DAM

HEC I DF

SHEET NO. A13 OF A14

PROJECT SC 171

1.02	2.30	53	26.50	140.	318.	107.	713.4
1.02	3.00	54	27.00	125.	290.	100.	713.3
1.02	3.30	55	27.50	112.	264.	97.	713.3
1.02	4.00	56	28.00	101.	239.	92.	713.2
1.02	4.30	57	28.50	90.	217.	82.	713.2
1.02	5.00	58	29.00	81.	196.	77.	713.2
1.02	5.30	59	29.50	72.	177.	72.	713.1
1.02	6.00	60	30.00	63.	160.	68.	713.1
1.02	6.30	61	30.50	55.	144.	64.	713.0
1.02	7.00	62	31.00	44.	129.	61.	713.0
1.02	7.30	63	31.50	20.	117.	57.	713.0
1.02	8.00	64	32.00	15.	109.	53.	713.0
1.02	8.30	65	32.50	11.	101.	49.	712.9
1.02	9.00	66	33.00	9.	94.	46.	712.9
1.02	9.30	67	33.50	8.	87.	42.	712.9
1.02	10.00	68	34.00	6.	81.	39.	712.8
1.02	10.30	69	34.50	5.	75.	36.	712.8
1.02	11.00	70	35.00	4.	69.	33.	712.8
1.02	11.30	71	35.50	3.	64.	31.	712.8
1.02	11.00	70	35.00	4.	69.	33.	712.8
1.02	11.30	71	35.50	3.	64.	31.	712.8
1.02	12.00	72	36.00	2.	59.	28.	712.7
1.02	12.30	73	36.50	2.	54.	26.	712.7
1.02	13.00	74	37.00	1.	50.	24.	712.7
1.02	13.30	75	37.50	1.	46.	22.	712.7
1.02	14.00	76	38.00	1.	42.	20.	712.7
1.02	14.30	77	38.50	0.	39.	19.	712.7
1.02	15.00	78	39.00	0.	36.	17.	712.6
1.02	15.30	79	39.50	0.	33.	16.	712.6
1.02	16.00	80	40.00	0.	30.	14.	712.6
1.02	16.30	81	40.50	0.	28.	13.	712.6
1.02	17.00	82	41.00	0.	25.	12.	712.6
1.02	17.30	83	41.50	0.	23.	11.	712.6
1.02	18.00	84	42.00	0.	21.	10.	712.6
1.02	18.30	85	42.50	0.	20.	9.	712.6
1.02	19.00	86	43.00	0.	18.	9.	712.6
1.02	19.30	87	43.50	0.	16.	8.	712.6
1.02	20.00	88	44.00	0.	15.	7.	712.6
1.02	20.30	89	44.50	0.	14.	7.	712.6
1.02	21.00	90	45.00	0.	13.	6.	712.6
1.02	21.30	91	45.50	0.	12.	6.	712.5
1.02	22.00	92	46.00	0.	11.	5.	712.5
1.02	22.30	93	46.50	0.	10.	5.	712.5
1.02	23.00	94	47.00	0.	9.	4.	712.5
1.02	23.30	95	47.50	0.	8.	4.	712.5
1.03	0.00	96	48.00	0.	7.	4.	712.5
1.03	0.30	97	48.50	0.	7.	3.	712.5
1.03	1.00	98	49.00	0.	6.	3.	712.5
1.03	1.30	99	49.50	0.	6.	3.	712.5
1.03	2.00	100	50.00	0.	5.	2.	712.5

PEAK OUTFLOW IS

3818. AT TIME 10.50 HOURS

CFS	3818.	3374.	1631.	806.	80643.
CMS	108.	96	46.	23.	2284.
INCHES		2.37	4.59	4.73	4.73
MM		60.30	116.57	120.11	120.11
AC-FT		1673.	3234.	3332.	3332
THOUS CU M		2063.	3989.	4110.	4110.

BY J.C. DATE 7/2/57  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

# LOUIS BERGER & ASSOCIATES INC.

LAKE LACKAWANA DAM  
HEC 1 DF

SHEET NO. 019 OF 415  
 PROJECT CC 271

## RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)

	AREA IN SQUARE MILES(SQUARE KILOMETERS)					
HYDROGRAPH AT	1	4616.	3846.	1665.	807.	13 22
	(	130.71)(	108.89)(	47.14)(	22.85)(	34.24)
ROUTED TO	2	3818.	3374.	1631.	806.	13.22
	(	108.11)(	95.53)(	46.17)(	22.84)(	34.24)

## SUMMARY OF DAM SAFETY ANALYSIS

	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM			
STORAGE	712.50	712.50	716.60				
OUTFLOW	0.	0.	578.				
			2799.				

RATIO OF PMF 0.00	MAXIMUM RESERVOIR W. S. ELEV 717.44	MAXIMUM DEPTH OVER DAM 0.84	MAXIMUM STORAGE AC-FT 727.	MAXIMUM OUTFLOW CFS 3818.	DURATION OVER TOP HOURS 5.50	TIME OF MAX OUTFLOW HOURS 10.50	TIME OF FAILURE HOURS 0.00
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